Introduction

Psalm 104-24, Oh Lord how manifold are thy works! In wisdom hast thou made them all: The earth is full of thy riches.

My name is Charles Reynolds, born in 1961 in the heart of gold country, Helena, Montana. Since the age of seven, I've had a gold pan in my hand, bound and determined to find gold in my grandfather's back yard--only to get into trouble for the two-foot-deep hole I had dug!

Since that time, and for over thirty years, I have prospected almost every gulch and stream in Montana where gold and gems have been found. I've spent thousands of hours on research, and many days and hours listening to stories of old miners with their tales of gold mining history.

I've worked several of my own placer operations, recovering hundreds of ounces of gold. I've worked in large scale mining of hard rock mines from exploration, drilling, heap leaching, and milling operations to design and fabricating mining equipment and gold recovery systems, to staking over eighty square miles of mining claims for different corporations.

Everyone knows of my passion for rocks and the inspiration I draw from Montana's mountain serenity. Appreciation goes out to my best prospecting partner, Robin, and for support and love from my daughters Nicole, Megan, and Christy. Thanks also to my dad, Lee Reynolds, Sr., for his knowledge of mining and mechanics made a base for my pursuit of gold mining lore.

Purpose

The purpose of this book is to help the inexperienced or experienced prospector to better their odds of finding gold. This book deals with areas in Montana where mainly coarse nugget gold has been found and still can be found with the use of a metal detector and other means, and gives information on mining techniques and their purposes.

This information comes from years of research at the Montana Bureau of Mines bulletins plus United States Geological Survey reports. Out of hundreds of streams, gulches and rivers, this book is limited to the best areas that yielded coarse nugget gold and still continue to produce.

This book is written from my personal experiences in gold prospecting. Available forest service maps show detailed areas that have high potential to produce gold nuggets. This book is written as a reference for determined prospectors to explain where gold nuggets have been found and can still be found.

You must always check land ownership, claim ownership and seek permission before entering any private land. In my experience by asking permission, 99% of the time I've been granted access to prospect on private land. Always respect all the wildlife habitats and livestock.

You should always respect all posted areas and respect others' land as if it were yours. If you open a gate, you close the gate behind you. If you pack it in, you pack it

out. Always be careful of fires. Obey all road restrictions for travel. Never travel off designated routes whether on private or public land. Always fill prospect holes and clean up all contaminate spills (oil, gas, etc.). Never pollute or contaminate a stream.

Obey all state and federal laws, wilderness restrictions and forest restrictions on private and public land.

Good luck: being persistent, having patience and reading this book, you will find gold!

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The Lay of the Land

Types of Placer Deposits

The following definitions will help you identify the various deposit features where coarse gold will likely be found. Marks on nuggets themselves give clues to their source and movement from source. Jagged nuggets, such as wire gold, have not had opportunity for smoothing from weathering or water transport and are likely near its formation. Flattened, rounded nuggets have signs of water wear. Fine and flour gold have broken down to smaller sizes and possibly carried great distances from their sources.

Residual Placer

Residual placer gold, formed originally in veins or lodes, have been released through rock weathering and remain close to its original position. It has therefore been concentrated without the aid of water transport.

Creek Placers

These are by far the most common type, and have been the most important source of placer gold. The gold is usually concentrated on bedrock or scattered throughout two or three feet of gravel immediately above bedrock.

Bench Placer or Terrace Placer

These are important sources of gold, and the occurrence and distribution of gold is much the same as in creek placers. They are generally ancient creek or river bar placers now situated above the present level of the creek or river.

River Bar Placers

River bar placers have also yielded a large amount of gold. A river bar is defined as being the portion of the riverbed that is exposed between high and low water. Usually the gold is more finely divided and evenly distributed within a given bar than in the gravel of a creek placer. The particles of gold are usually extremely small and flat, being sometimes fifteen times as broad as they are thick. The gold has generally traveled far

from its original source, is irregular and scattered in its deposition, does not concentrate on bedrock, and near the surface is generally carried downstream with the next high water. It is known as "float gold" and only in rare instances occurs in sufficient quantities to make the bar profitable.

Buried Placers

Another type of placer commonly found is the buried placer. Gold deposited in a creek placer that has later been covered with weathered rock and debris from adjacent banks, now lies buried at various depths. This type of deposit is generally mined through drifts.

Stream and Alluvial Placers

The formation of alluvial or stream placer deposits (river bar placers, bench placers, creek placers) by natural means involves a process similar to those used by the mining industry. The mining industry crushes and uses gravity concentration of ore minerals. In the natural process, alluvial placers are formed as a result of the disintegration or weathering of the mineralized veins and rocks, and the subsequent concentration of heavier minerals by the action of running water and gravity separation. Placer minerals are released from the lode or matrix rocks by natural weathering from wind, frost, rain, flowing streams, chemical action (as being turned to solution), changes in temperature, vegetation and movement in the earth crust. Working slowly throughout geological time, these agents gradually reduce rock to gravel, sand, silt and clay--releasing the precious metals and other heavy minerals contained in the rocks. The disintegrated materials are gradually moved down slope to the nearest watercourse by the action of wind, rain, and gravity settling. Upon reaching the stream, the moving water sweeps the lighter material away and the heavier placer minerals begin to settle toward the bottom of the streams and channels.

In order for concentration to take place, the placer minerals must have three properties: 1) a high specific gravity (weight); 2) durability (hardness or malleability); and 3) chemical resistance to weathering. Some of the other placer minerals contain not only gold but also gemstones and other precious metals.

The water concentration process involves a few principles based upon the difference of specific gravity, size and the shape of the mineral particles--as affected by the velocity and the movement of water.

Heavier minerals sink more rapidly in water than lighter ones of the same size. The difference in specific gravity is higher in water than in air. For example, the ratio of gold (specific gravity=19.3) to quartz (specific gravity=2.6) is about 7.4 to 1 in air and 11.4 to 1 in water, due to the weight of the water (specific gravity=1.0). The settling rate of the particles having the same weight but different size is affected by surface tension; rounded particles will settle much more rapidly than a flat or coarse particle.

The ability of flowing water to move or transport a solid object depends upon the velocity of the water and the material being moved. Most placer deposits are dropped whenever the current flow decreases.

Swirls and eddies in a stream current raise the lighter material from the bottom of the channel and allow the main current to wash them away. This shaking action moves

the lighter particles upward, where they are swept away--causing gold and other heavy metal minerals or gemstones to be concentrated on the bottom of the channel.

All of these factors operate together to naturally separate the finer and lighter minerals from the coarse and heavy ones. Over an extended period of time, the placer minerals can concentrate enough to constitute economic placer deposits. A change in gradient, obstruction, meandering or widening of a stream will produce conditions that enable heavier placer minerals to drop and accumulate.

A continuous supply of placer materials must be available for concentration in order to produce economic placer deposits. The most favorable regions for placer deposition are those containing mineralized rock formations that have undergone extensive erosion and experienced extended topographic relief, such as in large drops in elevation over long distances. Concentrations of heavy minerals are very favorable in areas that have undergone a recent geological uplift or where new canyons cut into older valleys. Consequently, rewashing and concentration of newly uplifted gravel has occurred. The more times such re-concentration of uplifted gravels on older gravels occurs, the higher degree of concentration of placer minerals is obtained in the newly formed placer deposit.

Alluvial or stream placers are the most important type of placer deposits and have yielded the largest quantities of metals and precious stones. Because of the ease of mineral extraction and the richness of some deposits, stream placers are as eagerly sought after today as in older days. Gold placers are often referred to as the poor man's mine because a single miner with a minimum capital investment can work them profitably. A brief description of placer deposition in several types of streambed deposits is included in the following information. Gold placer deposits are usually found in areas where lode gold deposits occur, even though some of the original sources of the gold could not have been profitably mined where the vein deposits were fairly shallow in depth. Erosion has sometimes been so complete that no trace of veins or lode can be found.

Placers are sometimes formed solely through weathering of the matrix rocks with little movement of the gravel, but are more commonly formed as a result of water transportation, sorting and deposition. The largest and heaviest gold particles are usually found a short distance from the source, while smaller and finer gold may have moved many miles from the place of origin.

In areas which have a high stream gradient, very little gold will lodge in the gorges, while extremely rich shallow gravel bars can accumulate in the bends and convex curves of the stream bed, and wherever the water is blocked by natural obstructions or is slowed down in more level or widened stretches of the streambed. Heavier gold particles or nuggets may lodge in natural riffles and ridges, or in cracks in the bedrock even in locations where the volume and velocity of the water are fairly high. In some places, these natural gold traps are cleaned every year, with subsequent deposition occurring during spring runoff each following year.

Most gold-bearing streams will have barren stretches as well as richer spots depending upon the conditions prevailing at the time the channel was formed. Streambeds are rarely rich directly opposite the mouth of a tributary stream, even if both streams are gold-bearing, as a result of the increased volume and velocity of the water at

the intersection. Very rarely, large quantities of gold are found in rapids and at the bottom of whirlpools. Gold, which lodges in such places, is usually thrown out or ground to powder by the milling action of the gravel and boulders.

The richer gold deposits are usually found inside curves of meandering streams, in pockets behind boulders, bedrock shelves in gravel bars which accumulate directly below major obstructions in swiftly flowing streams, and in areas where the streambed widens or levels out immediately below a narrow or steep section of the stream.

The erosion of older placers that have been deposited and then subsequently re-concentrated with greater values forms a number of richer placers. The secondary movement of the gold may be caused by a change in the stream gradient due to a rising or falling of the earth's crust or to an increase in the rate of water flow during periods of heavy runoff.

Gravel and sand in water become more or less mobile, allowing fine gold particles in the mass to slip downward and settle on the more impervious layers such as clay, cemented gravels or bedrock beneath the stream. Clays deposited by a stream become coherent and the fine gold becomes imbedded or trapped in them. Clays also work their way under boulders and are protected from disintegrating action of the water. Very rich pockets of gold have been found in clay accumulated under large boulders, which are close to the surface of the bedrock.

Gold is quite often found in gulches and ravines that are presently dry or contain little water. Some streams that contain deposits of gold can be found on the side or tops of the hills where they were left by streams that changed direction or disappeared entirely as the surface of the earth changed due to crust uplift or subsidence. Also, as streams cut deeper into the rock strata, or the direction of the flow changes, gravel bars are often left behind at higher elevation. These deposits are known to be bench or terrace placers and have contained some very rich gold-bearing gravel.

The pay streaks in dry placers are sometimes at or near bedrock, but are found more often on false bedrocks such as a clay layer, or sand and gravel cemented by caliche. Caliche is a calcium carbonate that leaches onto the rocks, cementing them in hardened layers called hardpan, or false bedrock. The gravels in dry placers are generally a mixture of fine and coarse materials which show very little stratification, except in natural streambeds which are only dry periodically or in more ancient stream beds or channels which exhibit the same stratifications found in recently deposited stream gravel.

Accumulation of placer minerals in rich gravel deposits requires a long, continued adjustment between stream velocity and the amount of gravel moved by the stream. It's been noted that the largest, richest placer deposits were formed in streams and rivers having a gradient of approximately 30 feet per mile. The gravels could not be too thick, had to be moving slowly downstream and had to be water-soaked in order for jigging or gravity separation to occur. The presence or absence of these conditions provides rich pay streaks in some streams and sparsely disseminated gold particles in other streams.

Gold has a tendency to occur in concentrated pay streaks, which may be fairly narrow and rich. Pay streaks may not be located in the present course of the stream and, if they are, are not necessarily in the central location due to changes in the gravel and channel travel. They are usually irregular in outline, having branches and splits, and are

completely absent in some spots. Even though a pay streak is present, some of the gold is usually scattered throughout the stream gravels. Any gold-bearing stream should be thoroughly sampled, as pay streaks are sometimes missed as a result of inadequate sampling.

A large number of placer deposits have very little or no relationship with the present topography or terrain features. This is especially true of those gravels deposited in the tertiary or early quaternary periods--the so-called ancient sands or rivers. Many of these ancient streambeds are buried under several hundred feet of lava or sediments. But it is highly possible to find rich placer where the earth crusted and rose up, exposing these ancient channels.

Most of the major placer deposits have already been discovered and worked, but this author, miner, prospector and believer knows, from his own finds, that rich placers can still be found by the determined prospector.

Water turbulence in streams and rivers also simulates the upward pulsations and vibrations of jigs, concentration tables, and gravity separation equipment.

Dry or Desert Placers

Deposits of gold particles in all placers are dependent upon a number of geological conditions existing at the time each deposit is formed. Ongoing climate changes are also significant. There are some basic characteristics typical of each type of placer deposit. It is those characteristics that can be used in determining where concentrations of gold are most likely to be found.

The deposit of gold in desert placers is different that river or stream placers. Desert placer deposits are composed of predominately angular gravels, mostly showing very little rounding or smoothness. Grinding and abrasion caused by continuous water transportation and sorting results in smooth gold. Gold particles do not usually work their way downward to false bedrock (as in caliche layers) cemented gravel, true bedrock or clay layers as rapidly as they would in a steady-flowing river or stream. Since the particles are suspended in the gravels at a higher level, the gold is much more accessible to secondary movement by subsequent surges of high water runoff. Because of the turbulence and the tremendous cutting power associated with sudden surges of heavy water flows over dry gravels, most of the gold particles are frequently redistributed and re-deposited throughout large volumes of thick gravel layers. Unless the gravels are subjected to subsequent, extended periods of fairly steady stream flows, the heavier metallic particles have very little opportunity to be sorted and concentrated into richer placer deposits. As a consequence, most desert placers contain a fairly even distribution of very find, small and medium gold particles mixed in the gravel mass.

It is also not uncommon to find larger and heavier pieces of gold near the surface, with most of the smaller particles being deposited at much lower levels. This condition results from the fact that the smaller particles can work their way downward much easier than the larger and coarser gold. However, the situation may be reversed when the larger gold particles were eroded first or during periods of maximum water flow and deeper erosion.

The gravel layers in desert placers are usually much more spread out and composed of a greater mixture of materials (soil, sand, pebbles, large boulders and

organic material) than those occurring in stratified gravels characteristic of stream deposits. In arid climates, these layers may be separated by narrow seams of clay, cemented gravel or sand formed during extended dry periods of time.

In most stream placers, the constant vibration of the water-saturated gravels by continuous water movement tends to settle the heavier and more resistant metal particles toward the bottom of the channel. This process is very similar when using shaker tables or gold pans. In desert areas the intermittent surges of water flow are usually of short duration, following cloudbursts or storms or rapid springtime snowmelt. The flow of water is of such a brief duration that the underlying gravels are not softened or saturated with moisture. Because of this condition, the vibration or jiggling action created by movement is normally limited to the top layer of the gravel mass. Under these conditions, the larger gold particles are normally deposited in fairly narrow streaks of limited lengths and depths, while the smaller particles are distributed throughout the surface gravels. Most of the pay streaks tend to be very irregular in occurrence and they can usually only be discovered by hit-or-miss prospecting efforts. Due to this irregular pattern of deposition, the use of prospecting techniques which apply to areas having more constant stream flow will most likely to be hindrance when prospecting desert placers.

The gold deposits in desert placers tend to be sporadic in nature, found in multiple layers of stratified gravel. Layers of clay or sand usually divide these bands. Some of these layers are gold bearing and some are not. Fairly narrow bands of gold-bearing gravels are sometimes sandwiched between barren bands of gravel. The sampling of any desert placer deposit should always be taken from the top to the bottom of the gravel mass and, if any gold is found each individual gravel layer, seam, strata or channel should be sampled. Some of these thin layers have been found to be fairly rich in gold content. The unwary prospector could very easily miss them.

Extremely fine gold will remain thoroughly mixed in the gravels and it will also travel long distances on the surface because of its ability to “float” on the surface of the water caused by surface tension of dry particles. Float gold will often be transported for many miles from its source, and it will be subsequently moved even further with each new surge of water. In addition, many of the smaller and most rounded gold particles will settle much more rapidly through angular gravels, due to their greatly reduced specific surface tension through angular gravels, as with the larger and coarser pieces. The nature of gold deposits in desert placers creates conditions normally associated with the formation of large, fairly low-grade placer deposits. It is also conducive to the formation of hidden placer deposits, which may be buried under a few feet to several hundred feet of overburden, as well as deposition of fairly rich, localized pockets and streaks of gold-bearing gravels. Many of these desert placers will be somewhat difficult to find and will involve very careful and extensive sampling to determine their value. However, it is also likely that many previously discovered desert placers could be mined at a profit because of the increase in gold prices and the potential of larger deposits being found with modern metal detectors.